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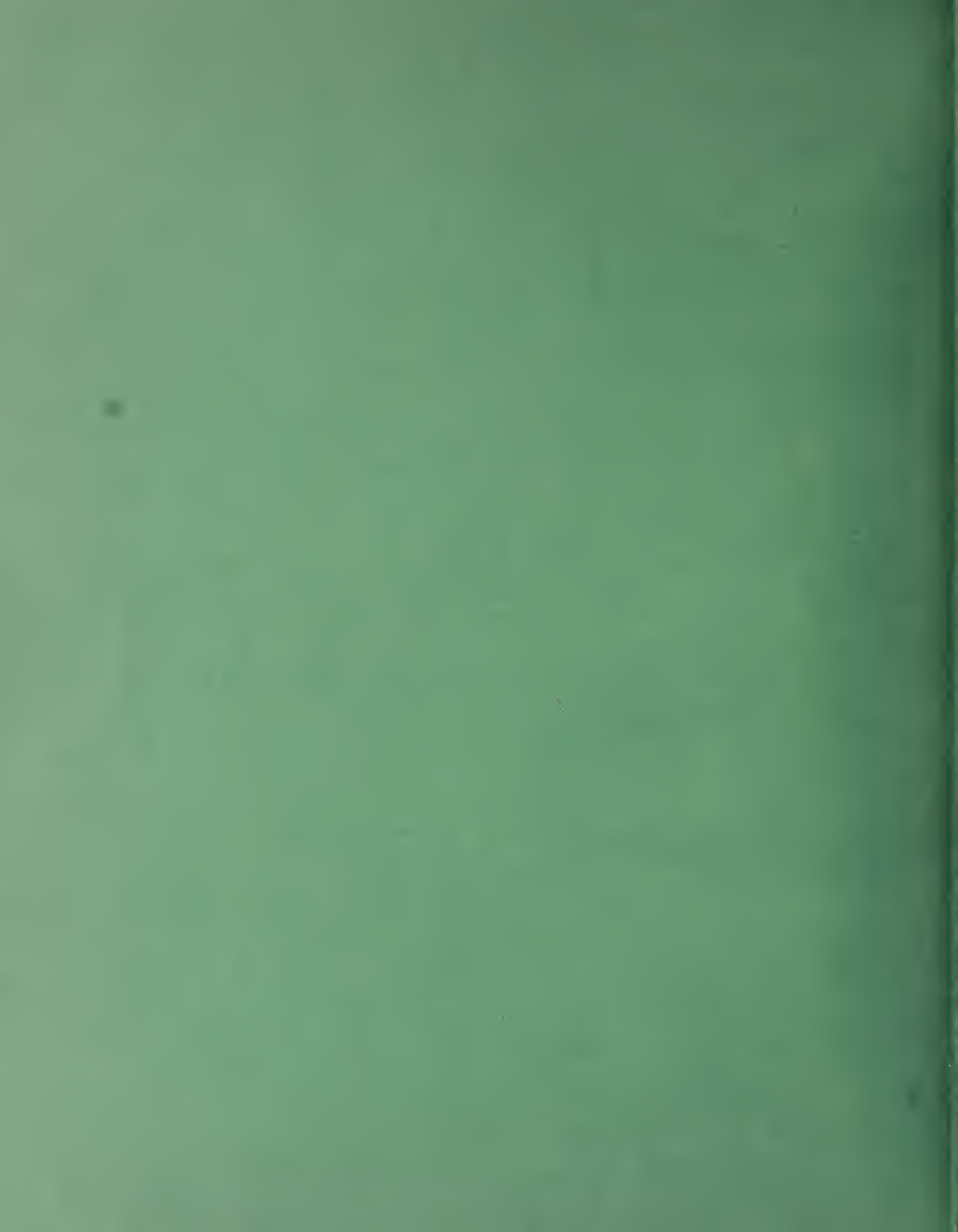
# Helium Resources of the United States, 1987

By Richard D. Miller



UNITED STATES DEPARTMENT OF THE INTERIOR





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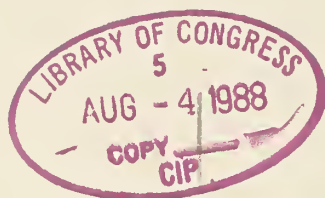
## **Helium Resources of the United States, 1987**

**By Richard D. Miller**

**UNITED STATES DEPARTMENT OF THE INTERIOR**  
**Donald Paul Hodel, Secretary**

**BUREAU OF MINES**  
**T S Ary, Director**

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

Bcf	billion cubic feet	psia	pound per square inch, absolute
°F	degree Fahrenheit	Tcf	trillion cubic feet
MMcf	million cubic feet	yr	year

# HELIUM RESOURCES OF THE UNITED STATES, 1987

By Richard D. Miller<sup>1</sup>

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## ABSTRACT

The helium resources base of the United States was estimated by the Bureau of Mines to be 1,040 Bcf as of January 1, 1987. These resources are divided into four categories in decreasing degree of assurance of their existence: (1) helium in storage and in proved natural gas reserves, 265 Bcf, (2) helium in probable natural gas resources, estimated at 228 Bcf, (3) helium in possible natural gas resources, estimated to be 320 Bcf, and (4) helium in speculative natural gas resources, 227 Bcf.

These helium resources are further divided into depleting and nondepleting, with the helium in storage being in a separate classification. The depleting resources are those associated with natural gasfields that are, or will be, produced for the natural gas they contain. Almost all of the helium in potential (probable, possible, and speculative) natural gas resources is included in this classification. These depleting resources are estimated to contain 951 Bcf of the total helium resource base. Helium resources contained in nondepleting natural gas resources, i.e., those in shut-in, abandoned, or otherwise nonproducing natural gasfields, are estimated to total 53 Bcf. There is 36 Bcf of helium in storage in the Federal Government-owned Cliffside Gasfield near Amarillo, TX.

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## INTRODUCTION

The helium resource base of the United States was estimated to be 1,040 Bcf as of January 1, 1987. This includes both identified and undiscovered helium contained in both proved and potential natural gas resources<sup>2</sup> and helium that was previously separated from natural gas streams and is in storage at Cliffside Gasfield in Bush Dome, Potter County, TX. This publication is the seventh in a series of reports on the helium resources of the Nation. The six previous reports gave information on those resources as of January 1, 1973 (1),<sup>3</sup> January 1, 1977 (2), January 1, 1979 (3), January 1, 1981 (4), January 1, 1983 (5), and January 1, 1985 (6). The Bureau of Mines (Bureau) has been estimating the helium resources of the Nation for over 30 yr in connection with a search for helium occurrences that has been conducted for 70 yr. These activities are carried on (1) to ensure a continuing supply of helium to fill essential Federal needs, (2) to provide information to the Secretary of the Interior so that the helium resources reserved to the United States on Federal land can be properly managed, and (3) to provide the public with information on a limited natural resource that is being wasted. The Mineral Leasing Act of 1920 reserves to the United States all helium found on Federal oil and gas leases. The responsibility for ensuring a supply of helium to meet essential Federal needs was assigned to the Secretary of the Interior by the Helium Act of March 3, 1925. The latest legislation on helium is the Helium Act Amendments of 1960. The helium resources estimates and production forecast presented in these reports are probably realistic for a relatively short term; however, as in all long-term forecasts, less reliance should be placed on the estimate toward the end of the forecast.

<sup>2</sup>See appendix for definition of terms.

<sup>3</sup>Underlined numbers in parentheses refer to items in the list of references preceding the bibliography and appendix at the end of this report.

The estimate of the total helium resource base of 1,040 Bcf compares with 1,070 Bcf estimated as of January 1, 1985. The decrease was mainly due to changes in the estimates of future natural gas resources by the Potential Gas Committee (PGC), the continued refinement in helium content averages by the Bureau, and natural gas production during the last 2 yr.

The helium resources are reported in four categories (table 1): (1) helium in storage and in proved natural gas reserves, (2) helium in probable natural gas resources, (3) helium in possible natural gas resources, and (4) helium in speculative natural gas resources. Helium in storage is the helium stored by the Department of the Interior in Bush Dome at Cliffside Gasfield near Amarillo, TX. Proved natural gas reserves are those estimated by the Department of Energy's (DOE) Energy Information Administration and those in nondepleting fields not included in the DOE estimate. The potential natural gas resources (probable, possible, and speculative) are those estimated to exist by the PGC. Additionally, 29 Bcf of helium is estimated to exist in nondepleting probable resources not included in the PGC estimates.

Helium in proved and probable natural gas resources is sometimes reported in terms of helium content ranges. These ranges are 0.3% or more, 0.05% to 0.29%,

TABLE 1. - Helium resources of the United States as of January 1, 1987

(14.73 psia and 60° F)

Helium resource category	Natural gas resource category	Helium, Bcf
Identified:		
Measured <sup>1</sup> ....	Proved.....	265
Indicated....	Probable.....	228
Undiscovered:		
Hypothetical.	Possible.....	320
Speculative..	Speculative.....	227
Total.....	NAp.....	1,040

NAp Not applicable.

<sup>1</sup>Includes helium in storage.

and less than 0.05%. The helium content ranges have no particular significance, but in general, the higher the percentage of helium, the more likely it is that the helium could be economically extracted. In earlier years, gas containing at least 0.3% helium (helium-rich gas) was the only gas of concern to the helium evaluation program. Now, because of the wider scope of the present helium resource

survey and because gases containing less than 0.3% helium can be economically processed, natural gases with less than 0.3% helium are included in the evaluation program. Helium recovery cost is affected by many variables besides the helium content of the natural gas. These include average daily rate of gas processed, hydrocarbon recovery, life of reserves, and total helium reserves.

## HELIUM RESOURCES

Helium occurs as a constituent of natural gas, which is presently the only economical source, although helium is also present in much smaller concentrations in the atmosphere. For this report, only those helium resources found in natural gas or previously separated from natural gas and now in storage are considered as a part of the Bureau's helium resources base. The natural gas in which helium is found may be normal fuel gas or naturally occurring gas of low heating value.

Helium contents of the natural gas resources were derived from Bureau records of helium analyses of natural gas samples, which are part of the Bureau resources data base. The analyses of natural gas and limited evaluations of helium resources were begun in 1917. Over 18,000 natural gas samples from wells and pipelines in the United States have been analyzed. Through 1987, 15,024 of these analyses had been published in 32 Bureau publications, which are listed in the bibliography of this report.

### HELIUM IN STORAGE

In 1961, the Government contracted to purchase helium from five extraction plants built by four private companies adjacent to large natural gas transmission pipelines. The gas, principally from the West Panhandle and Hugoton Gasfields in the Oklahoma and Texas Panhandles and in southwest Kansas, was being produced for fuel, and as the gas was burned, the helium was released to the atmosphere and wasted. Using private funds, these companies constructed plants

to extract crude helium for sale to the Government. The helium was delivered into a Government-owned pipeline that connected all plants with the Bush Dome in the Cliffside Gasfield near Amarillo, TX. Further information concerning the Government's helium purchases can be found in the first report of this series (1).

As of January 1, 1987, the helium stored in Bush Dome totaled 35.5 Bcf. This total comprises 33.8 Bcf that was accepted by the Government from the conservation plants under contract or was produced by Government-owned helium extraction plants and was excess to Federal market demands. The other 1.7 Bcf is stored by the Government for private companies under separate storage contracts.

Bush Dome was the source of helium-bearing natural gas that was processed for helium extraction at the Government's Amarillo Helium Plant from 1929 until the plant ceased helium extraction operations in April 1970. About 101 Bcf of the natural gas has been produced from the field, but there is about 207 Bcf of recoverable reserves remaining. The natural gas averages about 1.86% contained helium; therefore, remaining native helium reserves amount to 3.8 Bcf. Since the closing of the Amarillo Helium Plant, natural gas has been produced from this field to facilitate storage and the Government's Exell Helium Plant operations north of Amarillo, TX. Helium contained in the remaining native gas is included with the helium in proved natural gas reserves.

## HELIUM IN PROVED RESERVES OF NATURAL GAS

Helium in proved reserves of natural gas as of January 1, 1987, totals 229 Bcf. This is divided by helium content into three groups: 0.3% or more, 0.05% to 0.29%, and 0% to 0.04%. Presently, no helium is being extracted from gas streams with less than 0.3% helium. Known fields containing at least 0.3% helium and most fields in the 0.05% to 0.29% helium range have been identified and evaluated in the helium resources evaluation program. As of January 1, 1987, fields containing natural gas with helium contents less than 0.05% have not been separated and individually evaluated. Therefore, these helium resources are determined by use of average helium content values and DOE reported reserves.

### Natural Gas Containing 0.3% or More Helium

As of January 1, 1987, it was estimated that there was 192.3 Bcf of helium contained in proved natural gas reserves having at least 0.3% helium. These reserves were located in 97 fields in 12 States. The reserves by State are shown in table 2.

TABLE 2. - Helium reserves in proved natural gas reserves containing 0.3% or more helium, by State

(14.73 psia and 60° F)

<u>State</u>	<u>Helium, MMcf</u>
Alaska.....	61
Arizona.....	2,511
Colorado.....	1,950
Kansas.....	52,681
Montana.....	1,375
New Mexico.....	4,152
North Dakota.....	15
Oklahoma.....	7,495
Texas.....	18,205
Utah.....	3,505
West Virginia.....	113
Wyoming.....	100,213
Total.....	192,276

Since 1950, the Bureau of Mines has been making estimates of the helium resources of the Nation, although for several years the estimates included only the fields that contained major deposits of at least 0.3% helium. These fields were the Hugoton in southwest Kansas and the Oklahoma and Texas Panhandles, West Panhandle in Texas, Greenwood in Kansas, Keyes in Oklahoma, and Cliffside in Texas. Even today these fields are estimated to contain about 37% or 72 Bcf of the helium in gas with at least 0.3% helium. The natural gas from all these fields is being produced for fuel, and the helium that is not extracted is lost as the natural gas is burned. Bush Dome in Cliffside Field is being produced only for the Federal Government's helium program needs and for redelivery of helium stored under contract.

As the helium resources evaluation program progressed through the years, more comprehensive data were collected and the estimates were improved. In 1961, a major improvement in the program took place when, for the first time, helium reserves were estimated for all fields from which samples containing more than 0.3% helium had been analyzed in connection with the gas sampling program. Available data for many of these smaller fields were limited for the first evaluation efforts, but over the intervening years, data have been collected from all known available sources, and this has resulted in a comprehensive assessment of the total helium reserves of the country. The measured helium reserve estimates for each year beginning in 1950 appear in table 3, which also compares the trend of helium reserves of the United States with the natural gas reserves as estimated by the American Gas Association (AGA) through 1979 and DOE for 1980-86. This is shown graphically in figure 1.

Before the implementation of crude helium purchases in late 1962, all of the previously mentioned gasfields with large helium reserves were being produced for fuel. The resultant loss of helium amounted to about 8 Bcf per year. Under the crude helium purchase program, about 3.5 Bcf of the helium that would

TABLE 3. - Helium reserves in proved natural gas reserves containing 0.3% or more helium, by year

(Million cubic feet at 14.73 psia and 60° F)

Year	Helium contained in natural gas having at least 0.3% helium	Helium in storage	AGA and DOE estimates of natural gas reserves <sup>1</sup>
1950.....	248,642	82	179,401,693
1951.....	242,675	81	184,584,745
1952.....	242,675	86	192,758,910
1953.....	235,713	87	198,631,566
1954.....	229,745	86	210,298,763
1955.....	222,783	86	210,560,931
1956.....	216,816	70	222,482,544
1957.....	210,849	46	236,483,215
1958.....	203,887	24	245,230,137
1959.....	197,919	17	252,761,792
1960.....	192,946	106	261,170,431
1961.....	194,373	268	262,326,326
1962.....	194,373	438	266,273,642
1963.....	191,311	509	272,278,858
1964.....	187,855	2,042	276,151,233
1965.....	177,886	5,317	281,251,454
1966.....	169,695	8,870	286,468,923
1967.....	163,589	12,407	289,332,805
1968.....	155,076	16,138	292,907,703
1969.....	148,408	19,863	287,349,852
1970.....	140,386	23,693	275,108,835
1971.....	135,850	27,573	290,746,408
1972.....	127,873	31,491	278,805,618
1973.....	119,515	34,903	266,084,846
1974.....	113,470	37,426	249,950,207
1975.....	108,358	37,501	237,132,497
1976.....	101,152	37,760	228,200,176
1977.....	96,745	38,261	216,026,074
1978.....	89,783	38,651	208,877,878
1979.....	83,991	39,055	200,301,707
1980.....	82,293	39,399	194,916,624
1981.....	<sup>2</sup> 120,114	39,583	199,021,000
1982.....	128,504	39,424	201,730,000
1983.....	<sup>2</sup> 182,537	38,448	201,512,000
1984.....	198,565	37,687	200,247,000
1985.....	197,898	37,237	197,463,000
1986.....	194,925	36,397	193,369,000
1987.....	192,276	35,506	191,586,000

<sup>1</sup>AGA and DOE reserve estimates are given as of Dec. 31 of previous year.

<sup>2</sup>Increase due primarily to an increase in helium reserves in southwest Wyoming.

otherwise have been wasted was saved annually from 1963 through November 12, 1973, when acceptance of helium from the private conservation plants ceased. In

1986, about 671 Bcf of natural gas with a helium content of at least 0.3% was produced, which contained 4.3 Bcf of helium. About 1.0 Bcf of this helium was

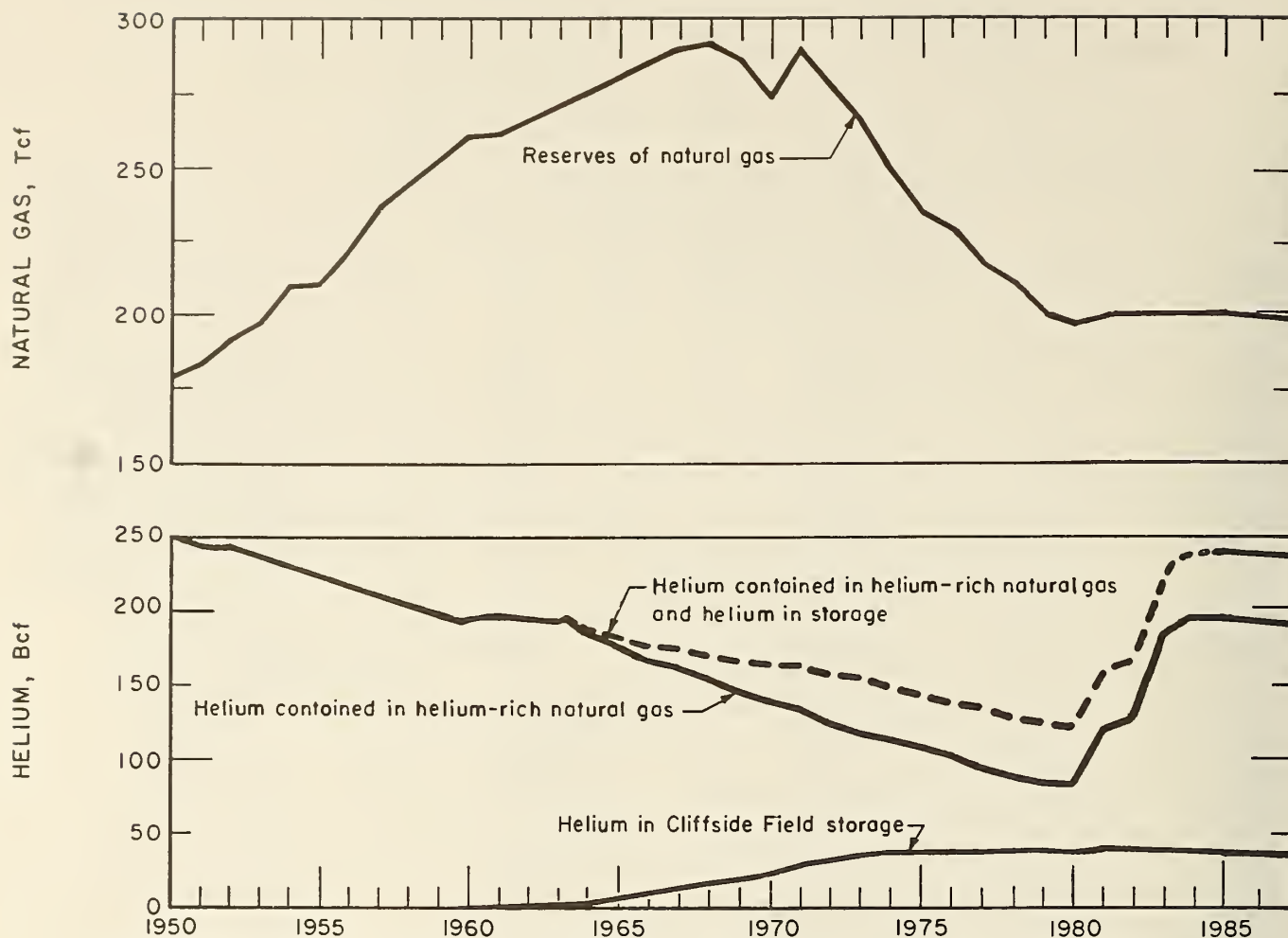


FIGURE 1.—American Gas Association and Department of Energy reserves of natural gas of the United States, helium in natural gas containing 0.3% or more helium, and helium in storage.

extracted by private plants and either used or stored in Bush Dome at Cliffside Field. The remainder, about 3.3 Bcf of helium, was lost to the atmosphere as the gas was used for fuel. The measured helium reserves of these producing fields are estimated to be 168.5 Bcf.

Some of the gasfields that contain gas with at least 0.3% helium are not being produced, and consequently, the helium is not being wasted. These are classified as nondepleting helium reserves. There are 40 fields in 7 States containing gas in this category, with measured helium reserves estimated to be 23.8 Bcf. There are various reasons why these fields are not being produced. Some are located in remote areas where pipeline connections are not presently available; in other

cases, the gas is being used in pressure maintenance operations to produce associated oil. In the majority of these fields, however, the helium is in natural gas that has low heating value and thus is not suitable for fuel. Fields in the first two groups will be put on production eventually, and the helium reserves will then be removed from the nondepleting category. As natural gas prices rise, some of the fields in the third group, those that were noncommercial at the time of discovery, will become profitable and then be produced. During 1986 one major field in this third group began production. Exxon Company, U.S.A., began production of the Madison Formation of the Riley Ridge Field in Sublette County, WY. This transferred about 80 Bcf helium

from the nondepleting to the depleting category of measured helium reserves.

About 83.3 Bcf of the depleting measured helium reserves and 16.7 Bcf of the nondepleting measured helium reserves are contained in natural gas located on Federal lands. The Government retains title to all helium on these Federal lands even though the oil and gas rights may be leased to private companies or individuals. The nondepleting reserves on Federal lands may serve as a backup to the helium stored by the Government and are an integral part of the Government's helium conservation efforts.

Natural Gas Containing  
0.05% to 0.29% Helium

The helium resources evaluation program was expanded in 1974 to include individual gasfields that produced gas with at least 0.1% helium but less than 0.3% helium. Some reasons for evaluating gas reserves with lower helium contents were the improved technology and economics of extraction operations made possible by multipurpose plants, making it feasible to process gas with lower helium contents. The evaluation of these fields was done on an area-by-area basis. The entire United States was evaluated at the end of 1982. The evaluation of individual fields with lower helium contents was expanded in 1983 to include individual gasfields that contain natural gas with at least 0.05% helium. Helium resources in the 0.05% to 0.29% category as of January 1, 1987, are shown in table 4.

Of the 11,655 MMcf of helium shown in table 4, only 75 MMcf is in nondepleting reservoirs, and 5,943 MMcf is in natural gas in fields located on Federal land.

Natural Gas Containing Less Than  
0.05% Helium

Helium resources in proved natural gas reserves that contain less than 0.05% helium are estimated to be 25.8 Bcf. This number was determined using DOE natural gas reserve estimates and the Bureau's estimated helium content of natural gas with less than 0.05% helium.

TABLE 4. - Helium resources in proved natural gas reserves with helium contents of 0.05% to 0.29%, by State

(14.73 psia and 60° F)

<u>State</u>	<u>Helium, MMcf</u>
Arkansas.....	410
Colorado.....	7,280
Kansas.....	637
Montana.....	685
North Dakota.....	204
Oklahoma.....	1,275
Texas.....	971
Wyoming.....	193
Total.....	11,655

The DOE has made annual estimates of the natural gas reserves of the United States since 1977,<sup>4</sup> and the estimates for 1986 were used to determine the volume of helium in the proved reserves of gas having less than 0.05% helium. The DOE estimate of proved natural gas reserves as of December 31, 1986 (7), was 191,586 Bcf. The estimate was made by combining estimates for several geographic divisions within the United States. Table 5 shows the gas reserve estimate for each geographical area, as published by the DOE.

The average helium contents for gases having less than 0.05% helium in each DOE reporting area are also shown in table 5. The helium content fractions were derived from the gas analysis data in the Bureau's helium analysis files. These values were then applied to the estimated natural gas reserves to determine the volume of helium contained in gases with less than 0.05% helium. For those areas also having gas with 0.05% or more helium, the volume of gas with 0.05% or more helium was subtracted from the total DOE reported volume before the helium content fraction was applied.

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<sup>4</sup>From 1945 through 1979, the AGA made annual estimates of the natural gas reserves of the United States. The AGA ceased making these reserve estimates after 1979.

TABLE 5. - DOE estimates of proved natural gas reserves as of December 31, 1986, with applicable helium content fraction and helium in gas having less than 0.05% helium  
(Volumes in billion cubic feet at 14.73 psia and 60° F)

Area	Natural gas reserves	Helium content fraction	Helium contained in natural gas having less than 0.1% helium
Alabama.....	951	0.00017	0.16
Alaska.....	32,664	.00014	<sup>1</sup> 4.57
Arkansas.....	1,992	.00017	<sup>1</sup> 1.29
California.....	5,253	.00003	.16
Colorado.....	3,027	.00032	<sup>1</sup> 1.86
Florida.....	49	.00015	.01
Kansas.....	10,509	.00012	<sup>1</sup> 1.50
Kentucky.....	841	.00023	.19
Louisiana:			
North.....	2,515	.00019	.48
South.....	35,869	.00004	1.43
Michigan.....	1,139	.00021	.24
Mississippi....	1,300	.00024	.31
Montana.....	896	.00025	<sup>1</sup> 1.05
New Mexico:			
East.....	2,694	.00037	<sup>1</sup> 1.12
West.....	9,114	.00026	<sup>1</sup> 1.94
New York.....	457	.00023	.11
North Dakota...	541	.00022	<sup>1</sup> 1.07
Ohio.....	1,420	.00014	.20
Oklahoma.....	16,685	.00026	<sup>1</sup> 3.61
Pennsylvania...	1,560	.00023	.36
Texas:			
Offshore.....	8,176	.00004	.33
District 1...	913	.00015	.14
District 2...	2,180	.00004	.09
District 3...	3,753	.00004	.15
District 4...	8,274	.00004	.33
District 5...	2,141	.00014	.30
District 6...	4,854	.00018	.87
District 7B..	684	.00016	<sup>1</sup> 1.11
District 7C..	2,721	.00047	1.27
District 8...	7,333	.00020	1.47
District 8A..	845	.00030	.25
District 9...	868	.00025	.22
District 10..	5,276	.00044	<sup>1</sup> 1.32
Utah.....	1,895	.00016	<sup>1</sup> 1.30
Virginia.....	253	.00014	.04
West Virginia..	2,148	.00030	<sup>1</sup> 1.64
Wyoming.....	9,756	.00014	<sup>1</sup> 1.33
Miscellaneous <sup>2</sup> ..	133	NA	NA
Total.....	191,586	NAP	25.80

NA Not available. NAP Not applicable.

<sup>1</sup>Natural gas reserves containing gases with helium contents of at least 0.05% were subtracted from total natural gas reserves to determine contained helium.

<sup>2</sup>Includes reserves of Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Oregon, South Dakota, and Tennessee.

## HELIUM IN POTENTIAL RESOURCES OF NATURAL GAS

The PGC has estimated that there was 738.5 Tcf of natural gas in the Nation's potential natural gas resource base as of December 31, 1986 (8).

The PGC, which reports on the potential gas supply of the Nation, is sponsored by the Potential Gas Agency, Colorado School of Mines. It is made up of representatives from the oil and gas producing industry, gas transmission industry, Government, and academic community. The committee made its initial report on future natural gas supply in 1967, although a predecessor committee, the Future Gas Supply Committee, produced a report on the same subject in 1964. The PGC reports potential natural gas resources by areas with geologic basin boundaries rather than geographic or political boundaries. There are seven PGC reporting areas, as shown in figure 2.

The potential resources of natural gas are broken down by the PGC into three

categories: probable, possible, and speculative. These are listed in the order of decreasing likelihood of existence; the probable category is associated with known fields, the possible category includes undiscovered fields in productive areas, and the speculative category covers resources to be found in presently unexplored areas. The PGC defines these terms more specifically as follows:

1. "Probable resources are associated with known fields and are the most assured of potential supplies. A relatively large amount of geologic and engineering information is available to aid in the estimation of the resource existing in this category. Probable resources bridge the boundary between discovered and undiscovered resources. The discovered portion includes the supply from future extensions of existing pools in known production reservoirs. The pools containing this gas have been discovered, but the extent of the pool has not been



FIGURE 2.—Potential Gas Committee area map.

completely delineated by development drilling. Therefore, the existence and quantity of gas in the undrilled portion of the pool are as yet unconfirmed. The undiscovered portion is expected to come from future new pool discoveries within existing fields either in reservoirs productive in the field or in shallower or deeper formations known to be productive elsewhere in the same geologic province or subprovince.

2. "Possible potential resources are a less assured supply because they are postulated to exist outside of known fields, but they are associated with a productive formation in a productive province. Their occurrence is indicated by a projection of plays or trends of a producing formation into a less well-explored area of the same geologic province or subprovince. The resources are expected to be found from new field discoveries, postulated to occur within these trends or plays under both similar and different geologic conditions (i.e., the types of traps and/or structural settings may either be the same or differ in some aspect).

3. "Speculative resources, the most nebulous category, are expected to be found in formations or provinces that have not yet proven to be productive. Geologic analogs are developed in order to ensure reasonable evaluation of these unknown quantities. The resources are anticipated from new pool or new field discoveries in formations not previously productive within a productive geologic province or subprovince and from new field discoveries within a geologic province not previously productive."

In comparing the PGC definitions with the terminology adopted by the Bureau and the U.S. Geological Survey, it appears that the PGC "probable" category is closely related to the Federal "indicated" category. This would then bring the "probable" resources into the "identified" range as shown in table 1. This is an apparent contradiction to the PGC's treatment of that class of reserves; however, it seems to be the best placement.

A Geological Survey report discusses the PGC estimates (9, p. 19), stating that the "probable category includes, however, some known resources, in the sense of having been discovered but not completely developed, and some unknown resources, so that the category brackets the boundary between the known and the unknown." For this report and the previous Bureau studies, the PGC "probable" category is compared with the "indicated" category under "identified" resources, and PGC's "possible" and "speculative" are compared with the "hypothetical" and "speculative" categories under "undiscovered" resources in Bureau terminology. It should be emphasized that these gas reserves are estimated to exist, but whether or not they will be discovered and produced will depend on many factors.

The helium contained in potential gas resources was estimated by using the average helium content of each PGC area. The average helium contents were determined for each PGC area by using helium contents of basins coded in the helium resources data base. The helium resources data basin codes were correlated with the PGC basin codes to derive the average helium content of each area. These helium contents range from 0.003% to 0.262%.

Helium contained in the potential gas resources was estimated to be 746 Bcf. In addition to this, the Bureau estimates that there is 29 Bcf of helium in probable resources of known fields containing nondepleting gas. The total helium resources then, in the indicated, hypothetical, and speculative categories, are 775 Bcf.

Table 6 shows the estimates of the natural gas resources for all areas of the continental United States and Alaska in the various categories designated by the PGC. Table 7 shows the volume of helium estimated to be contained in the natural gas resources shown in table 6. It is assumed that the helium content of the gas discovered in the future will be the same as that in past discoveries in all PGC areas.

TABLE 6. - Potential Gas Committee estimate of potential supply of natural gas in the United States as of December 31, 1986, by geographical area

(Volumes in trillion cubic feet at 14.73 psia and 60° F)

Area	Probable	Possible	Speculative	Total
Alaska.....	9.0	29.1	80.7	118.8
Atlantic.....	22.0	8.1	49.9	80.0
Gulf Coast.....	45.6	97.4	33.4	176.4
Mid-Continent.....	47.6	90.8	62.1	200.5
North Central.....	.2	4.1	10.3	14.6
Pacific.....	1.8	15.5	15.7	33.0
Rocky Mountain.....	36.6	53.3	25.5	115.4
Total.....	162.6	298.3	277.6	738.5

TABLE 7. - Estimated helium in potential supplies of natural gas as of January 1, 1987, by PGC area

(Volumes in billion cubic feet at 14.73 psia and 60° F)

Areas	Helium content, percent	Indicated helium in probable resources	Hypothetical helium in possible resources	Speculative helium in speculative resources	Total helium
Alaska.....	0.014	1.33	4.08	11.30	16.71
Atlantic.....	.061	13.39	4.96	30.42	48.77
Gulf Coast.....	.004	1.82	3.89	1.33	7.04
Mid-Continent.....	.182	86.64	165.26	113.01	364.91
North Central.....	.038	.07	1.56	3.92	5.55
Pacific.....	.003	.05	.47	.47	.99
Rocky Mountain.....	.262	<sup>1</sup> 124.94	139.60	66.73	331.27
Total.....	Nap	228.24	319.82	227.18	775.24

Nap Not applicable

<sup>1</sup>Includes 29.04 Bcf of helium in nondepleting resources.

#### DISSIPATION OF HELIUM RESOURCES

Estimates of future gas production of proved and potential resources for this report were based on extrapolations of gas supply estimates by the AGA (10). The AGA categorizes potential supply as follows: lower 48 States, Alaskan, imports, and other. For this study, the natural gas supply estimates for the lower 48 States and Alaska were used. In its report "The Gas Energy Supply Outlook 1987-2010," the AGA stated that "it is not expected that major deliveries of Alaskan gas will be brought to the lower 48 before 2000." The completion of the Alaskan Highway Project pipeline depends

on the demonstrated need for Alaskan gas in the lower 48 States. For this reason and other problems recently announced, it is doubtful that the pipeline can be built and gas delivered to the lower 48 States by year 2000. However, for this study, 2000 was considered the starting date for natural gas to be transported through the Alaskan Highway Project pipeline.

The AGA gas supply estimates for the lower 48 States for 1990 ranged from a low-price scenario of 16 Tcf to a high-price scenario of 17 Tcf. The AGA year 2010 supply estimates ranged from 11.5 to

14 Tcf from the lower 48 States and from 0.7 to 1.2 Tcf from Alaska. Actual 1986 production was 15.6 Tcf from the lower 48 States and about 0.3 Tcf from Alaska.

To forecast available helium in natural gas produced for market, the average helium content for each area was applied to those forecasted gas production rates. Since the AGA forecasts were made only through the year 2010, it was necessary

to extend them through 2020 for the purposes of this report. The extension was based on past production (shown on figure 3), the AGA forecast through 2010, the volume of proved reserves, and the undiscovered gas resources estimated by the PGC. The forecasted natural gas volumes and the helium expected to be produced with the gas are shown in table 8 and on figures 4 and 5.

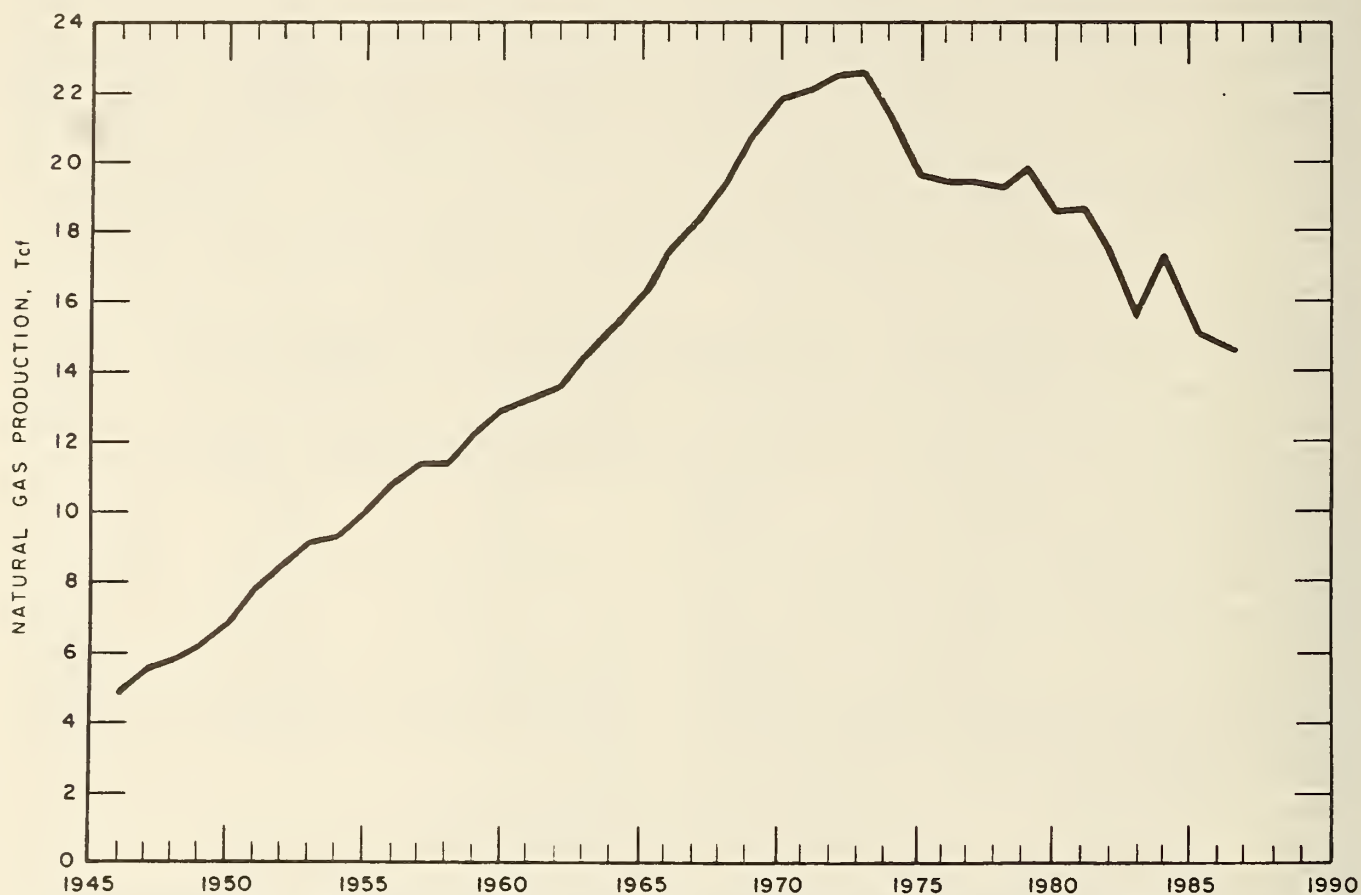


FIGURE 3.—American Gas Association annual gas production estimates for 1945-79 and Department of Energy gas production estimates for 1980-86.

TABLE 8. - Projected natural gas and helium production in the United States

(Billion cubic feet at 14.73 psia and 60° F)

Year	Natural gas production	Contained helium	Year	Natural gas production	Contained helium
1987.....	15,897	16.3	2004.....	16,611	18.7
1988.....	16,295	16.8	2005.....	16,611	18.7
1989.....	16,497	17.5	2006.....	16,611	18.6
1990.....	16,900	18.4	2007.....	16,110	18.5
1991.....	16,903	18.8	2008.....	16,511	18.2
1992.....	16,906	19.1	2009.....	16,410	18.1
1993.....	16,907	19.3	2010.....	16,410	18.0
1994.....	16,908	19.6	2011.....	16,311	17.9
1995.....	16,910	19.8	2012.....	16,311	17.7
1996.....	16,911	19.9	2013.....	16,213	17.7
1997.....	16,911	20.1	2014.....	16,213	17.7
1998.....	16,910	20.0	2015.....	16,113	17.6
1999.....	16,910	19.9	2016.....	16,113	17.4
2000.....	16,910	19.5	2017.....	16,009	16.9
2001.....	16,909	19.3	2018.....	15,908	16.6
2002.....	16,811	19.1	2019.....	15,908	16.4
2003.....	16,810	19.0	2020.....	15,807	16.2

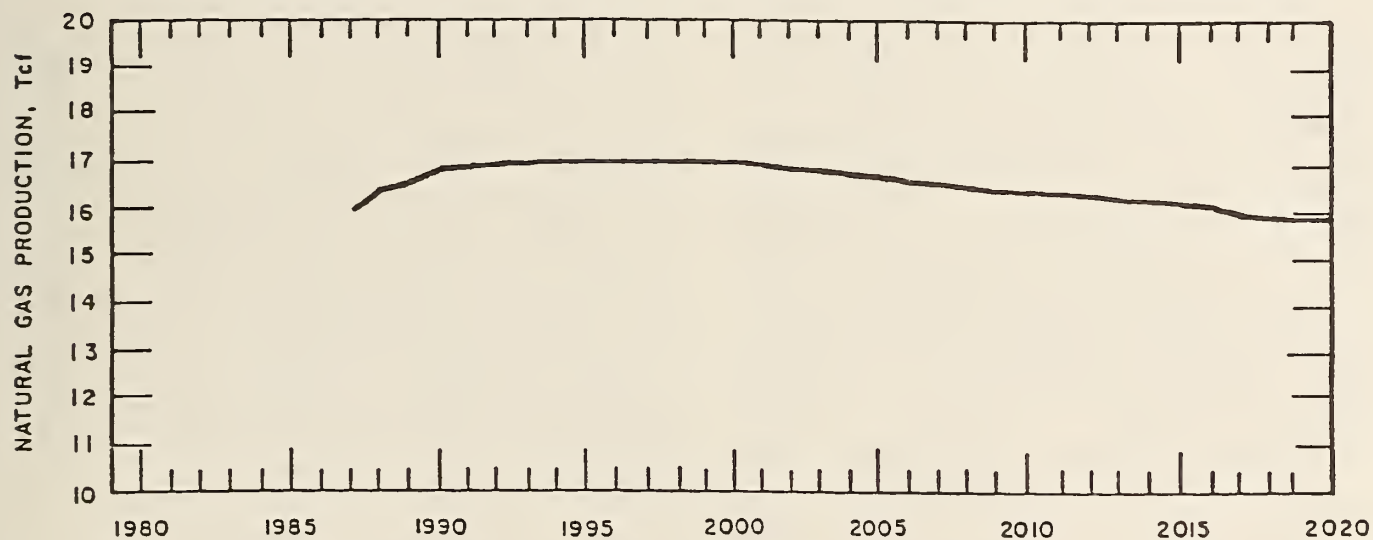


FIGURE 4.—Projected natural gas production in the United States.

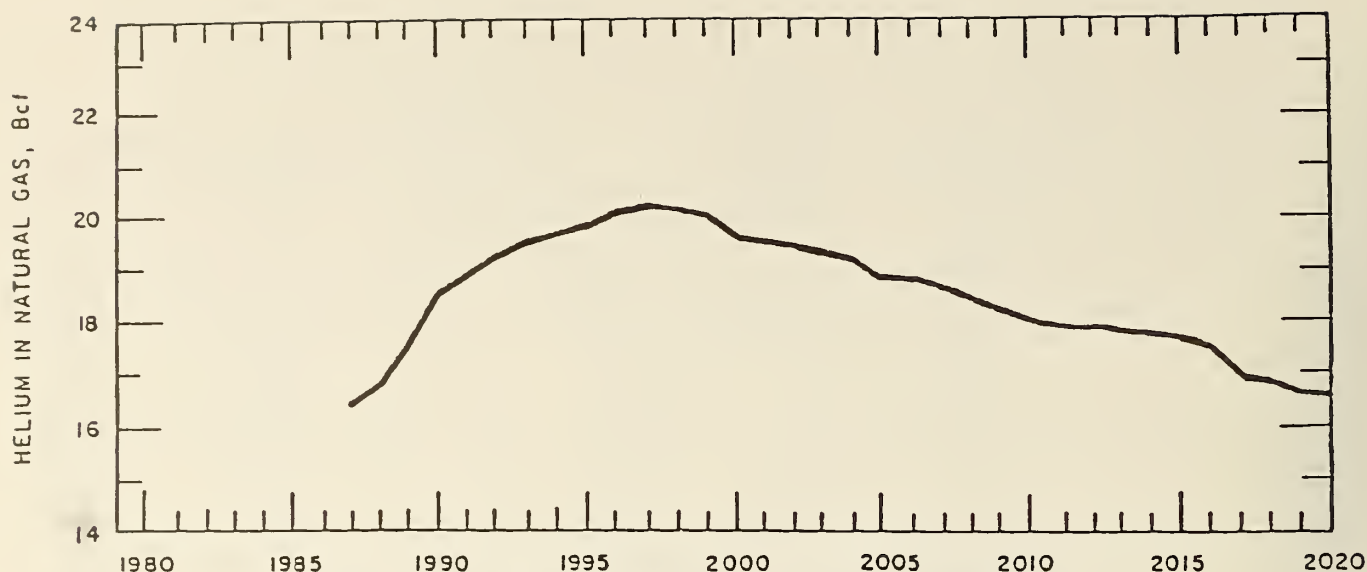


FIGURE 5.—Projected helium in natural gas production in United States.

#### CONCLUDING STATEMENT

In the previous Bureau reports on helium resources, it was concluded that relatively large volumes of helium would be available from natural gas through the year 2020, although that helium would probably be in gases with leaner concentrations than those being processed for helium today. There have been no developments in the past 2 yr to alter these conclusions. Because of the expected leaner concentrations of helium in natural gas, extraction plants will have to process larger quantities of gas to recover equivalent volumes of helium. This will probably require that the extraction plants be located on gas transmission systems that bring large

volumes of natural gas together at one point.

As of January 1, 1987, there was 35.5 Bcf of helium in storage in Bush Dome at Cliffside Gasfield. The Bureau of Mines own 33.8 Bcf, and 1.7 Bcf is owned by private companies and is stored under separate storage contracts. There is also about 3.8 Bcf of helium contained in the native gas in Bush Dome, which is owned by the Federal Government. This reserve of helium and the helium on Federal lands in presently nondepleting fields will fulfill the Bureau's mission of supplying helium to meet all essential Government needs for many years beyond 2000.

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APPENDIX.--GLOSSARY<sup>1</sup>

*Helium Resource*--All helium contained in natural gases and helium that has been extracted from natural gases and is being stored for future use.

*Helium Reserve*--The portion of the identified helium resource that is in storage and the helium contained in the proved resources of gases containing at least 0.3% helium. These are the resources now being processed for helium or those most likely to be processed if helium demand is increased.

*Helium in Storage*--The helium stored by the Federal Government in Cliffside Field.

*Identified Resource*--A collective term for the helium in both measured and indicated resources.

*Measured*<sup>\*</sup>--Helium in gas reserves for which estimates have been made with a margin of error of less than 20%.

Measured resources are comparable to those reserves termed "proved" by the gas industry.

*Indicated*<sup>\*</sup>--Helium in gas resources associated with measured reserves for which estimates have been made by using reasonable engineering and geologic projections.

Indicated resources are comparable to those resources termed "probable" by the gas industry.

*Undiscovered Resources*--Unspecified deposits of helium surmised to exist on the basis of broad geologic knowledge and theory.

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<sup>1</sup>Asterisk (\*) beside a term indicates that there is a comparable gas industry term; these terms are explained at the end of the entry.









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